

Docket No. 10010504-1

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

PATENT APPLICATION:
Serial No. 09/921,022ORIGINALLY FILED:
August 2, 2001FOR:
SLEW RATE CONTROL OF OUTPUT
DRIVERS USING FETS WITH
DIFFERENT THRESHOLD VOLTAGES

INVENTORS: Humphrey

GROUP ART UNIT: 2816

EXAMINER: Nguyen, M.

DOCKET NUMBER: 10010504-1

FAX RECEIVED

JUN 3 2003

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RESPONSE AFTER FINAL PURSUANT TO 37 C.F.R. 1.116

Assistant Commissioner for Patents
Washington, DC 20231

Sir:

In response to the Office Action mailed April 22, 2003, please enter this response without amendment in the above-identified patent application and consider the remarks as follows:

REMARKS

Claims 1-7 are pending in the application and are presented for reconsideration without amendment. No new matter has been added.

Claim Rejections

Claims 1, 3-4, and 7 are rejected under 35 U.S.C. § 102(b) as being anticipated by US Patent No. 5,036,222 to Davis.

Claims 2 and 5-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent No. 5,036,222 to Davis in view of US Patent No. 5,877,647 to Vajapey et al.

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I. Rejections of Claims Under 35 U.S.C. § 102

1. Legal standard for Rejecting Claims Under 35 U.S.C. §102

Under 35 U.S.C. § 102, a claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros., Inc. v. Union Oil Co.*, 814 F.2d 628 (Fed. Cir.), *cert. denied*, 484 U.S. 827 (1987).

2. Response to 35 U.S.C. § 102 Rejections

a. Claims 1, 3-4, and 7

Claim 3 recites:

An apparatus for reducing the slew rate of transition edges of a digital signal on a node of an integrated circuit, comprising:

a first switchably conductive device characterized by a first threshold voltage, said first switchably conductive device connected between said node and a voltage source and responsive to a driving signal to allow current conduction from said voltage source to said node when said driving signal is offset from said voltage source by a voltage substantially equal to and greater than said first threshold voltage and to disallow said current conduction when said driving signal is offset from said voltage source by a voltage less than said first threshold voltage; and

a second switchably conductive device characterized by a second threshold voltage greater than said first threshold voltage, said second switchably conductive device connected between said node and said voltage source and responsive to said driving signal to allow current conduction from said voltage source to said node when said driving signal is offset from said voltage source by a voltage substantially equal to and greater than said second threshold voltage and to disallow said current conduction when said driving signal is offset from said voltage source by a voltage less than said second threshold voltage.

The Examiner seeks to make the following equivalences: a first switchably conductive device N1 characterized by a first threshold voltage (the voltage which starts to turn ON transistor N1), said first switchably conductive device connected between said node VOUT and a voltage source GROUND and responsive to a driving signal VIN to allow current conduction from said voltage source to said node when said driving signal is offset from said voltage source by a voltage substantially equal to and greater than said first threshold voltage and to disallow said current

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conduction when said driving signal is offset from said voltage source by a voltage less than said first threshold voltage (when VIN changes, VOUT changes, and when VI changes to a first certain voltage, transistor N1 is ON first, the first threshold voltage is the VIN voltage at this first moment, and when the voltage of VIN is less than this first threshold voltage the current conduction is disallowed through N1, col. 10, lines 16-36); and

a second switchably conductive device (transistors N3 and P4) characterized by a second threshold voltage (the VIN voltage which starts to turn ON transistor N3) greater than said first threshold voltage (col. 10, line 35, i.e., two steps or "bifurcated turn on"), said second switchably conductive device connected between said node and said voltage source and responsive to said driving signal to allow current conduction from said voltage source to said node when said driving signal is offset from said voltage source by a voltage substantially equal to and greater than said second threshold voltage and to disallow said current conduction when said driving signal is offset from said voltage source by a voltage less than said second threshold voltage (VIN keeps changing, VOUT also keeps changing accordingly, and when VIN changes to a second certain voltage, transistor N3 is ON, the second threshold voltage is the VIN voltage at this second moment, and when the voltage of VIN is less than this second threshold voltage, the current conduction is disallowed through N3).

The Applicant respectfully traverses the rejection of claim 3 under 35 U.S.C. § 102(b). Davis does not meet the limitations of claim 3. In formulating the rejection of claim 3, the Examiner seeks to equate Davis's transistor combination P4 and N3 with Applicant's "second switchably conductive device characterized by a second threshold voltage greater than said first threshold voltage", and Davis' VIN to Applicant's "driving voltage".

The Applicant offers the following example to illustrate why this equivalence cannot stand:

Assume VIN is high and the signal has propagated to the output node so VOUT is high. When this condition is met, transistors P1, N4, and P3 are each ON and transistors N1, P4, and N3 are each OFF. Now assume that VIN begins to transition from high to low. At some point, the signal on the gate to N1 will begin to

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increase in voltage, while at the same time, the signal on the gate to P1 will begin to also increase in voltage. Assuming a threshold voltage of $|0.6|$ V for the NFETs VT_{N1} , VT_{N2} , VT_{N3} , and VT_{N4} and PFETs VT_{P1} , VT_{P2} , VT_{P3} , and VT_{P4} , and $VCC = 5$ V, the voltage on the gate of N1 needs to reach 0.6 V ($GND + VT_{N1}$) before it turns ON. In operation, in order for the gate of N1 to reach 0.6 V, VIN will have to have transitioned below 4.4 V (i.e., $VCC - VT_{P_inverter\ 12}$) in order to turn ON the PFET in inverter 12 and much further below 4.4 V in order to turn OFF the NFET in inverter 12. Note that the PFET in inverter 12 must be ON in order to turn ON NFET N1.

Once N1 turns ON, it pulls the signal on VOUT low, turning on P4 when $VOUT = 4.4V$ ($VCC - VT_{P4}$). Meanwhile, while P4 turns ON, N2 is turning off, thus allowing N3 to turn ON once the voltage on the gate of N3 reaches 0.6 V ($GND + VT_{N3}$).

Importantly, the Applicant contends that the driving voltage on N1 is the voltage at the gate of N1, whereas the driving voltage of the combination P4 and N3 is the signal present on VOUT (since N3 cannot turn ON until P4 first turns ON).

In contrast, the Examiner seeks to equate Davis' VIN with Applicant's "driving voltage". However, this equivalence cannot stand. According to the Examiner's equivalence map, the second switchably conductive device is the combination of P4 and N3. The Applicant agrees with the Examiner's statement at page 6, lines 6-8 of the Office Action that the "second threshold of the "second switchably conductive device" should read on the voltage applied to the input node of the combination of FETS N3 and P4 in order to allow current conduction from the voltage source to the output node." As described above, the input node of the combination of FETS N3 and P4 is the gate of P4 (i.e., output node VOUT) since N3 cannot turn ON until P4 has turned ON. Thus, in the Examiner's proposed equivalence map, the second threshold voltage is that voltage applied on the gate of P4 sufficient to turn ON P4 (or under the assumptions in our example, 4.4 V ($VCC - VT_{P4}$)). However, while in this example the second threshold voltage is certainly greater than the first threshold voltage 0.6 ($GND + VT_{N1}$) of the proposed first switchably conductive device N1, the proposed driving voltage VIN does not meet the limitations of Claim 3.

Claim 3 recites "a second switchably conductive device characterized by a second threshold voltage greater than said first threshold voltage, said second

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switchably conductive device ... responsive to said driving signal (VIN) to allow current conduction from said voltage source (GROUND) to said node (VOUT) when said driving signal (VIN) is offset from said voltage source (GROUND) by a voltage substantially equal to and greater than said second threshold voltage ($VIN \geq 4.4V$) and to disallow said current conduction when said driving signal (VIN) is offset from said voltage source by a voltage less than said second threshold voltage ($VIN < 4.4V$). However, clearly by the time P4 begins to allow current conduction to turn ON N3, VIN is substantially equal to 0 V (i.e., $VIN \ll 4.4V$). Thus, according to Claim 3, "said second switchably conductive device" should be "responsive to said driving signal (VIN) ... to *disallow* said current conduction when said driving signal (VIN) is offset from said voltage source by a voltage less than said second threshold voltage ($VIN < 4.4V$)". Clearly, however, since P4 doesn't even begin to conduct until VIN is well below the threshold voltage of 4.4V of the P4/N3 combination, Davis operates *opposite* to that required by Applicant's claim 3.

In addition, in Davis when $VIN \geq 4.4V$ the signal on the gate of N1 is low, and thus N1, P4, and N3 are each OFF. This is in direct contrast to the requirement recited in Applicant's claim 3 of "said second switchably conductive device ... responsive to said driving signal (VIN) to *allow* current conduction from said voltage source (GROUND) to said node (VOUT) when said driving signal (VIN) is offset from said voltage source (GROUND) by a voltage substantially equal to and greater than said second threshold voltage ($VIN \geq 4.4V$)".

Accordingly, VIN cannot be equated with Applicant's driving signal as proposed by the Examiner.

Furthermore, there is no other signal in Davis that can be equated with Applicant's "driving signal" that meets the limitations of Claim 3.

In summary, Davis does not meet the limitations of Applicant's claim 3, including "a second switchably conductive device characterized by a second threshold voltage greater than said first threshold voltage, said second switchably conductive device connected between said node and said voltage source and responsive to said driving signal to allow current conduction from said voltage source to said node when said driving signal is offset from said voltage source by a voltage substantially equal to and greater than said second threshold voltage and to disallow

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said current conduction when said driving signal is offset from said voltage source by a voltage less than said second threshold voltage". Per *Verdegaal Bros., Inc. v. Union Oil Co.*, *supra*, since Davis does not teach each and every element as set forth in claim 3, Davis cannot be used in formulating a rejection under 35 U.S.C. § 102(b). Accordingly, the Applicant respectfully requests the Examiner to withdraw the rejection.

As per claim 4, claim 4 recites the same limitations as claim 3 and adds additional limitations. For the same reasons that Davis does not meet the limitations of claim 3, Davis also does not therefore meet the limitations of claim 4. Accordingly, the Applicant respectfully submits that the rejection of claim 4 under 35 U.S.C. § 102(b) should be withdrawn.

As per claim 1, claim 1 recites similar limitations as claim 3, in method form, including "a first switchably conductive device characterized by a first threshold voltage ... to allow current conduction from said voltage source to said node when said first input signal is offset from said voltage source by a voltage substantially equal to and greater than said first threshold voltage and to disallow said current conduction when said first input signal is offset from said voltage source by a voltage less than said first threshold voltage" and "a second switchably conductive device characterized by a second threshold voltage greater than said first threshold voltage ... to allow current conduction from said voltage source to said node when said second input signal is offset from said voltage source by a voltage substantially equal to and greater than said second threshold voltage and to disallow said current conduction when said second input signal is offset from said voltage source by a voltage less than said second threshold voltage". For the same reasons that Davis does not meet the limitations of claim 3, Davis also does not therefore meet the limitations of claim 1. Accordingly, the Applicant respectfully requests that the Examiner withdraw the rejection of Claim 1.

As per claim 2, claim 2 recites the same limitations as claim 3 and adds additional limitations. For the same reasons that Davis does not meet the limitations of claim 1, Davis also does not therefore meet the limitations of claim 2. Accordingly, the Applicant respectfully requests that the Examiner withdraw the rejection of Claim 2.

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As per claim 7, claim 7 recites similar limitations as claim 3, including "a first switchably conductive device characterized by a first threshold voltage ... to allow current conduction from said voltage source to said node when said first input signal is offset from said voltage source by a voltage substantially equal to and greater than said first threshold voltage and to disallow said current conduction when said first input signal is offset from said voltage source by a voltage less than said first threshold voltage" and "a second switchably conductive device characterized by a second threshold voltage greater than said first threshold voltage ... to allow current conduction from said voltage source to said node when said second input signal is offset from said voltage source by a voltage substantially equal to and greater than said second threshold voltage and to disallow said current conduction when said second input signal is offset from said voltage source by a voltage less than said second threshold voltage". For the same reasons that Davis does not meet the limitations of claim 3, Davis also does not therefore meet the limitations of claim 7. Accordingly, the Applicant respectfully requests that the Examiner withdraw the rejection of Claim 7.

II. Rejections of Claims Under 35 U.S.C. § 103

1. Response to Rejections of Claims Under 35 U.S.C. § 103

The Applicant repeats all of the arguments presented with respect to Davis, Vajapey, and Kaplinsky in the prosecution history to date. As presented in those arguments, neither Vajapey, Kaplinsky, nor any of the other prior art of record makes up for the deficiencies of Davis with respect to Claim 3. Accordingly, Claim 3 could not be construed as being obvious over the prior art of record.

As per claim 5, claim 5 recites the same limitations as claim 3 and adds additional limitations. The limitations of claim 5 are not met for the same reasons that the limitations of claim 3 are not met by Davis, nor any of the other prior art of record taken in any combination. Accordingly, the Applicant respectfully requests the Examiner to withdraw the rejection of Claim 5.

As per claim 6, claim 6 recites the same limitations as claim 3 and adds additional limitations. The limitations of claim 6 are not met for the same reasons that the limitations of claim 3 are not met by Davis, nor any of the other prior art of

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record taken in any combination. Accordingly, the Applicant respectfully requests the Examiner to withdraw the rejection of Claim 6.

As per claim 9, claim 9 recites the same limitations as claim 3 and adds additional limitations. The limitations of claim 9 are not met for the same reasons that the limitations of claim 3 are not met by Davis, nor any of the other prior art of record taken in any combination. Accordingly, the Applicant respectfully requests the Examiner to withdraw the rejection of Claim 9.

As presented in the arguments presented with respect to Davis, Vajapey, and Kaplinsky in the prosecution history to date, neither Davis, Vajapey, Kaplinsky, nor any of the other prior art of record, taken in any combination, makes up for the deficiencies of Davis with respect to claim 1. Accordingly, Claim 1 could not be construed as being obvious over the prior art of record, and therefore the Applicant respectfully requests the Examiner to withdraw the rejection of Claim 1.

As per claim 2, claim 2 recites the same limitations as claim 1 and adds additional limitations. The limitations of claim 2 are not met for the same reasons that the limitations of claim 1 are not met by Davis, nor any of the other prior art of record taken in any combination. Accordingly, the Applicant respectfully requests the Examiner to withdraw the rejection of Claim 2.

The application is now believed to be in condition for allowance.

III. Entry of Amendment After Final Rejection Under 37 C.F.R. § 1.116

The claims have not been amended and therefore a new search is therefore not required. The Applicant merely responds to the Examiner's refutation of Applicant's previous Response and respectfully requests consideration of this Response.

Accordingly, the Applicant respectfully submits that entry of this Amendment after Final Rejection is proper under 37 C.F.R. § 1.116.

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CONCLUSION

In view of the foregoing remarks, it is respectfully submitted that none of the references cited by the Examiner taken alone or in any combination shows, teaches, or discloses the claimed invention, and that Claims 1-7 are in condition for allowance. Reexamination and reconsideration are respectfully requested.

Should the Examiner have any questions regarding this amendment, or should the Examiner believe that it would further prosecution of this application, the Examiner is invited to call the undersigned.

Respectfully submitted,



May 31, 2003

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